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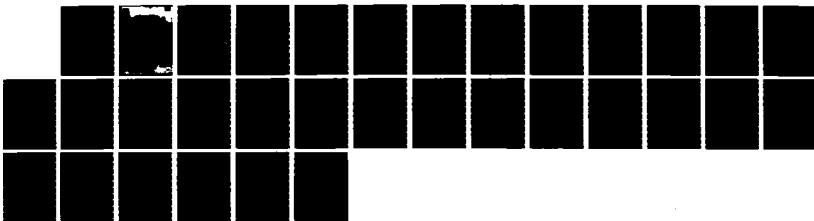
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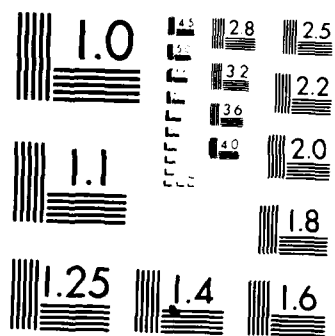
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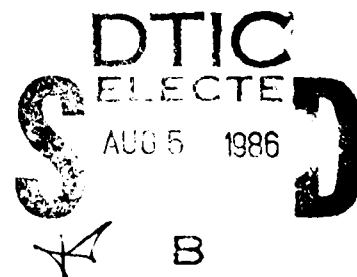
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MANAGEMENT OF ELECTRONIC  
TEST EQUIPMENT

VOLUME IV: DoD POLICY

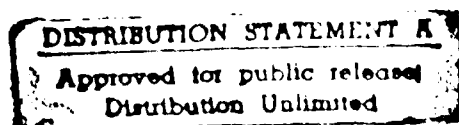
July 1986

Frans Nauta



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## PREFACE

The Department of Defense (DoD) has a long history of problems with the acquisition and support of test equipment. In a previous report, Test Equipment Management, January 1985, we summarized the nature and extent of the underlying problems and recommended that the Assistant Secretary of Defense (Manpower, Installations, and Logistics), ASD(MI&L), take the lead in effecting needed improvements. The ASD(MI&L) concurred with that recommendation and established a "DoD Test Equipment Management Improvement Program" under the overall guidance of the Maintenance Directorate. This report presents a set of actions for that program.

The report is published in four volumes. Volume I presents a program of action for improving test equipment management and support within the DoD. Volume II reviews previous studies and initiatives pertaining to test equipment management and support. Volume III describes how the Military Services are organized to carry out that management and support. Volume IV reviews and assesses the adequacy of related DoD policy.

Throughout the report, all references to military organizations apply to the situation in early 1985. Subsequent organizational changes, such as the Navy's disestablishment of the Naval Material Command and the reorganization of Naval Electronic Systems Command into Space and Naval Warfare Systems Command, are not reflected in the text. As a result, several old office symbols and references are used. Similarly, several recent events regarding test equipment management and support may not be included.



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## 1. INTRODUCTION

Each of the Military Services, as well as the Office of the Secretary of Defense (OSD), uses its own nomenclature for test equipment. For purposes of this report, we use the term "test equipment" as a specific category of support equipment: i.e., electric/electronic test, measurement, and diagnostic equipment (TMDE), defined to include manual electronic test equipment (ETE), automatic test equipment (ATE), test program sets, and calibration equipment.

This volume reviews and assesses current Department of Defense (DoD) policy on test equipment management and support. Although no directives or instructions specifically address test equipment, many are concerned with the management and support of materiel, including test equipment. These latter directives and instructions are reviewed here for the management functions of standardization, acquisition, life cycle support, inventory management, cataloging, and readiness monitoring. Those reviews are presented in Chapter 2 of this volume, while Chapter 3 assesses the overall adequacy of current DoD policy.

## 2. REVIEW OF DoD POLICY GUIDANCE

### STANDARDIZATION

Standardization of test equipment is explicitly stated as an objective for DoD equipment maintenance in a recent reissuance of DoD's basic maintenance policy directive, DoD Directive 4151.16, "DoD Equipment Maintenance Program," 23 August 1984:

Maintenance tooling, equipment, test equipment, and skills for similar-type workloads shall be standardized to the extent feasible among the Military Departments. [E.18]

That directive does not define standardization nor does it refer to the single policy directive on standardization, DoD Directive 4120.3, "Defense Standardization and Specification Program," 10 February 1979.

The latter directive establishes policies governing the Defense Standardization and Specification Program (DSSP) that encompass "functions concerned with achieving an optimum degree of uniformity among the variety of items, materials and engineering practices in all phases of the life cycle of systems and equipment developed for or used by the Department of Defense." The objectives of the DSSP "are to improve the operational readiness of the DoD Components and assure the cost-effective mission performance of systems and equipment by fostering the efficient use of resources and optimum reuse of the products of engineering efforts." This directive provides considerable procedural guidance including:

- The DSSP shall be a planned program under which standardization documents (specifications, standards, handbooks, drawings) are prepared and maintained with management authority and responsibilities for portions of the program delegated to the DoD Components.
- Military operational requirements for materiel shall be satisfied to the maximum practical extent through the use of existing acceptable commercial and military designs, products, and practices.
- Standardization shall be an essential consideration during systems and equipment acquisitions, including "inter" and "intra" system standardization of items. The degree



and effectiveness of standardization efforts will be addressed during Defense System Acquisition Review Council milestone reviews.

- The number of items in supply shall be minimized by establishing efforts to control the entry of items into supply and to eliminate nonessential items from the supply system.
- Standardization documents generated under the DSSP shall state only the actual needs of the Government and describe materiel requirements or engineering practices that will be subject to recurring application in such a way as to encourage maximum competition. Such documents shall reflect engineering practices/products of the private sector (unless unique military requirements are essential), shall permit maximum flexibility in their application, and shall undergo coordination with interested Government and non-Government activities prior to issuance.
- Standardization documents issued by non-Governmental organizations shall be adopted and used instead of military standards whenever practical (see DoD Instruction 4120.20, "Development and Use of Non-Government Specifications and Standards," 28 December 1976).

The directive assigns responsibility for DSSP policy to the Under Secretary of Defense for Research and Engineering (USDR&E), with the Defense Materiel Specifications and Standards Board serving in an advisory capacity, and the Defense Materiel Specifications and Standards Office (DMSSO) administering and managing the program. It requires the Secretaries of the Military Departments to provide the resources to assure effective implementation of DSSP policies and to designate a standardization office responsible for the DSSP. It also authorizes the Secretaries to delegate their authority within the scope of standardization assignments to heads of activities within their departments. Finally, it establishes reporting requirements, including an annual "Standardization Accomplishment Report" and a quarterly "Status of Standardization Projects."

#### DSSP Administration

Standardization in general consists of three elements: (1) developing and agreeing on standard characteristics of products, practices, and data so they can be used cost effectively in multiple applications; (2) communicating those agreements (standards) to the users; and (3) selectively applying the standards in the acquisition of materiel. The DSSP is a disciplined program for the development, publication, and periodic review of standards under the day-to-day management of DMSSO with the Deputy Assistant Secretary (Acquisition Management) responsible for overall policies and procedures. Defense products are classified by Federal Supply Class (FSC) and

management/engineering practices are identified as "standardization areas." For each FSC and standardization area, a military organization known as an "assignee activity" (for FSCs) or "lead service activity" (for standardization areas) is delegated the responsibility for analyzing, planning, and ensuring that optimal standardization is accomplished. For example, the Army's Communications-Electronics Command is assignee activity for FSC 6625, and the Air Force Systems Command's standardization office is the lead activity for automatic test technology standards. Altogether, there are 31 standardization areas. Development of the actual standardization documents is performed by military organizations known as "preparing activities"; assignee or lead activities may function as preparing activities or delegate that function to other organizations. There are over 90 preparing activities, each responsible for one or more FSCs or standardization areas. Both the preparing activities and assignee activities are assisted by various other organizations (participating activities, custodians, review, and user activities) in the planning, management, and preparation of standardization documents. Detailed procedures are outlined in the Defense Standardization Manual, DoD 4120.3-M (current issue Change 3, dated January 1982), issued by the Office of the USDR&E.

Standardization documents include specifications (for repetitively procured products) and standards (for engineering/management practices, processes, services, and data). They are divided into three groups: (1) Federal documents covering civilian-type products and services used by the DoD, (2) military documents covering products and services that are inherently military, and (3) non-Government documents issued by private sector organizations for products or services commonly available to the general public. Whenever possible, the DoD uses performance-oriented specifications and standards rather than detailed design specifications. It also adopts non-Government specifications and standards for commercial products and practices whenever practical. The annual DoD Index of Specifications and Standards (DoDISS) identifies all Federal, military, adopted non-Government, and international standardization documents. Weekly bulletins ("DoDISS Notices") provide advance information about new or revised standardization documents. DoDISS lists approximately 45,000 documents. Personnel from the Naval Publications and Forms Center, Philadelphia, Pennsylvania, which is the single stock point within DoD for all documents listed in

DoDISS, state that the total number of military standardization documents is approximately 26,000, with each document ranging from a few pages to several hundred pages. These documents are stored in a large warehouse, in which document storage and retrieval are manual operations.

Federal documents include commercial item descriptions, Federal specifications, and Federal standards. Commercial item descriptions are simplified Federal specifications describing the salient physical and/or functional characteristics of acceptable commercial/modified commercial products. They are identified by an "A-A" identifier preceding the assigned number. Federal specifications are more detailed than commercial item descriptions in that they contain a complete description of the item and the provisions for determining compliance with the requirements. They are developed for commercial products when specific design, performance, or other essential characteristics cannot be adequately described in a commercial item description. They are identified by two groups of letters (the first group identifying the commodity and the second representing the first letter of the title of the document) followed by the assigned number. Federal standards cover engineering or management processes, practices, or techniques used by, or with the potential for use by two or more Federal agencies. These documents are identified by "FED-STD" preceding the document number.

Military documents include military specifications, which are identified by the prefix "MIL" or "DoD" (for documents in the metric system) followed by the first letter of the first word in the title of the document and the assigned number; and military standards, which are identified by the prefix "MIL-STD" or "DoD-STD" (for metric standards) followed by the document number.

Other standardization documents include handbooks and qualified products lists. Handbooks are reference documents supplementing specifications or standards to provide general engineering or technical data. The qualified products lists identify products that have been "qualified" in the past, i.e., tested and evaluated to meet specific performance requirements spelled out in Federal or military specifications. Such lists are intended for those products for which multiple acquisitions by both Government and original equipment manufacturers are expected and the time or test equipment required to perform testing to assure acceptability of product design, safety, and

quality make it impractical to conduct the tests after contract award. By policy, the use of qualified products lists must be explicitly justified; the associated specifications must be qualified and the tests must be identified; and each qualified products list must contain at least two sources for each required product.

Other related documents include international standards, such as North Atlantic Treaty Organization Standardization Agreements, Quadripartite Army or Navy Standardization Agreements, other international committee standards, and standards prepared by nationally recognized industrial and trade associations and professional societies. Such industry standards are either adopted by DoD (and thus included in DoDISS) or may be referenced in a military standardization document.

The Defense Standardization Manual contains detailed guidance on the planning, preparation, publication, application, and review of standardization documents. Each assignee activity is responsible for preparing a program analysis for each assigned FSC and each lead Military Service activity is responsible for preparing a program plan for each assigned standardization area. All standardization activities are required to participate in the development of a 5-year program, comprising all current and planned standardization projects and program analysis/plans. DMSSO issues standardization program guidance annually for use by the Military Services, Civil and Defense Agencies, and the General Services Administration in their development of project schedules and budgets. Consolidated reports on standardization accomplishments are submitted annually by each Military Service to DMSSO.

With regard to specifications for commercial products, Chapter VI of the Defense Standardization Manual refers to the policy established by the Office of Management and Budget, which states that "the Government will purchase commercial, off-the-shelf products when such products will adequately serve the Government's requirements, provided such products have an established commercial market acceptability," and which requires elimination of all unnecessary

Government specifications for commercial products and packaging. Consequently, DoD specifications for commercial products are prohibited unless one or more of the following exceptions apply: (1) they are required to give visibility to avoid duplication of product descriptions; (2) they are required to avoid proliferation of products in the DoD supply system; (3) they are required to enable Government documentation and configuration control; (4) they are required by law, regulations, or foreign agreements; and (5) no acceptable non-Government document exists. If a military specification is still required, the manual prescribes the following procedure: (1) determine whether one or more commercial items are available with an established market acceptability that can meet the established need; (2) prepare the specification with minimum specific requirements enabling purchase of the acceptable commercial products off-the-shelf; (3) exclude any requirements, such as packaging and quality assurance requirements, that are not essential and justify the need for essential requirements; and (4) assure that the specification supports the chosen acquisition strategy for the product, including acquisition method, storage, distribution, and logistics support.

The final chapter of the manual includes warnings about the improper application of standards and specifications and urges maximum flexibility (selected application and tailoring as afforded by properly written specifications) in order to reap the potential benefits of standardization without incurring unnecessary costs.

#### Observations

As indicated in the previous description, the DSSP is oriented toward the administration of standardization documents, not the control of end items.<sup>1</sup> It is a useful program as long as the system is kept up to date. That program, however, will have little effect, by itself, on end-item proliferation, as recognized by DoD Directive 4120.3 which explicitly points out the need for "establishing efforts to control the entry of items into supply."

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<sup>1</sup>This orientation is required by law [Cataloging and Standardization Act, originally enacted on 1 July 1952, as Public Law (P.L.) 82-436, improved on 10 August 1956, by P.L. 84-1028, and codified as Title 10, U.S. Code, Sections 2451 through 2456, in 1976].

Given below are several observations on specific efforts which could reduce substantially the proliferation of common ETE.

The DoD needs to develop a single Preferred Items List (PIL), with each Military Service PIL being a subset. One way to formalize such a PIL would be to revise DoD Directive 4120.3 to include procedural guidance on the use, maintenance, and application of that PIL in controlling the entry of commercial off-the-shelf and modified commercial ETE.

The DoD needs to exercise care in selecting modified commercial ETE because of the potential for higher cost, greater delay, and reduced reliability that often result from even minor modifications and because uncontrolled purchases of modified commercial equipment in the past has been one of the major contributors to proliferation. (Both of these points were emphasized by the Defense Science Board Task Force on Electronic Test Equipment in its February 1976 report entitled "Use of Off-the-Shelf Electronic Test Equipment to Reduce Costs, Shorten Leadtimes, Assure Reliability, and Simplify Logistics.")

If designed properly, the DoD PIL would define the salient characteristics for each category of ETE and would contain at least two preferred items for each category. New items would not be added to the list without a thorough evaluation and test (preferably through bid sample testing procedures, which are, by their very nature, open and competitive). Although the competition requirement could be satisfied by having one item in the PIL for each category, that approach would not be in the best interests of the Government. Just as qualified products lists have always required at least two sources of supply, the PIL should not mandate sole source dependency but rather limit the variety to a minimum of two items.

To clarify the controversy between standardization using a PIL and legal competition requirements, we extract the pertinent paragraphs from the Federal Acquisition Regulations (FAR) and its DoD supplement (DFARS)

Part 6, "Competition Requirements," of the FAR lists a number of exceptions for which full and open competition need not be provided. Among those exceptions, it lists the following example under the first exception ("only one responsible source"):

When the agency head has determined in accordance with the agency's standardization program that only specified makes and models of technical equipment and parts will satisfy the agency's needs for additional units or replacement items, and only one source is available. [FAR Section 6.302-1(b)(6)]

The DFARS clarifies this authority as follows:

The authority of FAR 6.302-1(a) shall not be used in the case of acquisitions described in FAR 6.302-1(b)(6) unless the equipment or parts have been adopted as standard items of supply in accordance with DoD Standardization Program (see DoDD 4120.3 and Departmental procedures). This authority shall not be used for initial acquisitions of equipment or spare parts, or to select arbitrarily the equipment or parts of certain suppliers. [Defense Acquisition Circular 84-10, 10 January 1985]

The Military Services seldom have used this authority (referred to as "exception 13" procurement under the previous Armed Services Procurement Regulations) because of the long delay involved in justifying and obtaining approval at the Assistant Secretary level. As a result, repurchases for needed test equipment often have been recompeted, resulting in unnecessary proliferation. The current FAR provides for a simpler approval process (Section 6.304) and, moreover, permits a class justification (instead of justifications for each individual procurement contract). The provision of class justification (FAR 6.303-1), however, is under dispute. The General Accounting Office (GAO) believes this provision is in conflict with the Competition In Contracting Act that became effective for solicitations issued after 31 March 1985. Although that act does not state whether justifications and approvals for the first six exceptions to full and open competition (as specified in FAR 6.302-1 through 6.302-6) must be on a case-by-case basis or may be on a class basis, the GAO interprets the act as requiring a case-by-case justification/approval, based on Congressional intent reflected in the House and Senate Conference Committee Report No. 98-861.<sup>2</sup> If GAO's interpretation stands and

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<sup>2</sup>See: Comptroller General, "Federal Regulations Needed To Be Revised To Fully Realize The Purposes Of The Competition In Contracting Act Of 1984" (Washington, D.C.: U.S. General Accounting Office, 21 August 1985)

FAR 6.303-1 must be revised, OSD should pursue amending the act to permit a class justification for standardization within "exception 1." Increased standardization has long been an interest of Congress.

The requirements for using the DoD PIL should be firmly established in the acquisition policies and procedures of each Military Service, with specific requirements for justifying waivers from and for monitoring adherence to procuring the preferred (standard) items.

The DoD requires some type of Joint Service review of existing PILs to delete items that are obsolete and those that have a poor record (inadequate logistics support, poor reliability/maintainability, excessive calibration requirements, etc.).

Most of all, the DoD PIL must provide needed flexibility. To illustrate, multiple items must be maintained on the PIL for each category of ETE when the Military Services have different requirements. As an example, the Navy's requirements for shielding against electromagnetic interference are more stringent (because of the shipboard operating environment) than those of the Air Force and Army, so that the standard signal generators of the latter two would be inadequate for Navy use.

#### ACQUISITION

DoD acquisition policy directives and instructions focus on major defense systems (weapons and communications systems) and treat test equipment as one of the associated logistic support elements. Thus, most of the specific guidance contained in these documents is directed at the prime equipment, not support equipment. The work breakdown structures for various types of defense systems are defined in MIL-STD-881A, "Work Breakdown Structures for Defense Materiel Items," 25 April 1975. Generally, common and peculiar support equipment are part of the total system, although each type is further subdivided into two groups – support equipment that is used primarily for field maintenance, and support equipment that is used for depot maintenance only.

The four major acquisition directives and instructions are summarized first, then we address several acquisition issues that are particularly relevant to test equipment.



## Major Acquisitions

DoD Directive 5000.1, "Major System Acquisitions," 29 March 1982, establishes broad policy on acquisition management and the acquisition process for major defense systems. Among the management principles and objectives, it lists the following:

- Effective design and price competition shall be obtained to the maximum extent practicable.
- Operational suitability of deployed weapons systems is as equally important an objective as operational effectiveness. (Operational suitability is defined as "the degree to which a system can be placed satisfactorily in field use, with consideration being given to availability, compatibility, transportability, interoperability, reliability, wartime usage rates, maintainability, safety, human factors, manpower supportability, logistic supportability, and training requirements.")
- Resources to achieve readiness will receive the same emphasis as those required to achieve schedule or performance objectives.
- Reasonable stability in acquisition programs is necessary. To achieve stability, DoD Components shall: (1) conduct effective long-range planning; (2) consider evolutionary alternatives such as preplanned product improvements; (3) estimate and budget realistically; (4) plan to achieve economic rates of production, maintain surge capacity, and meet mobilization requirements; and (5) develop a specific acquisition strategy at the inception of each program.
- A cost-effective balance must be achieved among acquisition costs, ownership costs, and system operational effectiveness.
- The impact of DoD acquisition on the industrial base must be considered for the near-term and long-range implications.

It further specifies the phases of the acquisition process, the requirements for each milestone, and the functional responsibilities of OSD and the Military Departments.

DoD Instruction 5000.2, "Major System Acquisition Procedures," 8 March 1983, implements the above directive and provides procedural guidance for the Defense System Acquisition Review Council and the milestone review process. It also specifies documentation requirements, including the Decision Coordinating Paper and the Integrated Program Summary that is required for Milestone II decisions. The Decision Coordinating Paper is a summary-level document limited to 18 pages (including annexes) in a prescribed format, identifying alternatives considered, technological risks, goals and thresholds, and acquisition strategy; it normally does not address support

equipment. The Integrated Program Summary is a more detailed document that provides some visibility of the support concept, including deficiencies of current or planned support systems to meet logistical objectives such as maintenance turnaround time, resupply item, and ATE capacity. The Integrated Program Summary also provides detailed cost information, with support equipment costs broken down into common and peculiar support equipment.

The third key acquisition directive, DoD Directive 5000.40, "Reliability and Maintainability," 8 July 1980, implements the principles set forth in the above two documents and establishes policies and responsibilities for the reliability and maintainability (R&M) of defense systems, subsystems, and equipment. The directive states the objective of R&M activities to be fourfold: (1) operational effectiveness (increasing operational readiness and mission success probability of fielded items); (2) ownership cost reduction (reducing demands for maintenance and logistic support, both on-equipment and off-equipment); (3) limitation of manpower needs (constraining operating and maintenance personnel to the skills and training expected to be available); and (4) management information (collecting R&M data essential to acquisition, operation, and support management). The criterion for R&M activities is that each increment in cost or schedule spent on R&M must contribute significantly to these four objectives. The overall policy requires each R&M program to consist of a balanced mix of R&M engineering and accounting tasks, with reliability engineering focused on the prevention, detection, and correction of design deficiencies, weak parts, and workmanship defects, maintainability engineering focused on the reduction of maintenance and repair times, task complexity of maintenance actions, and special tools and test equipment; and R&M accounting focused on generating the information essential to acquisition, operation, and support management.

The directive defines a variety of R&M terms and measurement parameters; describes the management of R&M growth during full-scale development and initial deployment; and outlines the required monitoring of R&M in the acquisition process through demonstrations and tests, and at

program milestone reviews. Importantly, it directs that R&M activities not be terminated with the fielding of a weapons system, but that:

- The acquiring agency shall continue to correct operational R&M deficiencies to ensure that R&M goals are achieved.
- Specific offices shall be established to investigate and resolve operational R&M deficiencies of items no longer under the responsibility of an acquisition program
- Data collection systems shall be used for reporting measured values of system R&M parameters and for identifying operational R&M deficiencies
- Actions shall be taken to reduce the extent of "false alarms" at all levels of maintenance, including the provision of test facilities that are capable of diagnosing failures not found by conventional troubleshooting without environmental stress.
- Specifications for spares, reprocurments, or modifications shall have no less stringent R&M requirements than those for the original equipment, upgraded as necessary to correct R&M deficiencies.

The directive explicitly charges the Secretaries of the Military Departments with several responsibilities, including the following:

- Identifying R&M parameters applicable to each type of system they operate or acquire, defining metrics for those parameters, and ensuring their data collection systems trace those parameters.
- Establishing R&M requirements for each item, based on a defined item life profile including environmental conditions and skill levels of operator and maintenance personnel.
- Analyzing operational R&M deficiencies to determine their causes and identifying tradeoffs between improvement of materiel and improvements of concepts or policies.

Similar requirements for test equipment life cycle support management would also seem appropriate, but will not be defined unless directed by OSD.

The fourth major acquisition directive, and probably the most important for test equipment, is DoD Directive 5000.39, "Acquisition and Management of Integrated Logistic Support for Systems and Equipment," 17 November 1983. It establishes the requirement for life cycle management of major system integrated logistic support (ILS) and provides guidance for ILS policy applicable to nonmajor systems and equipment. It mandates an ILS program beginning at the inception of a major system acquisition program and continuing for the life of the system, with the primary

objective to achieve system readiness requirements at an affordable life cycle cost. Early ILS activities are to influence the system design toward desirable support characteristics and to determine support requirements. Subsequent activities are to develop, evaluate, and field the needed support resources. Throughout the acquisition cycle, ILS planning and resource decisions shall be based on the Logistic Support Analysis as specified in MIL-STD-1388 and tailored to the acquisition program. The directive includes detailed procedural guidance and provides a checklist of ILS considerations for each milestone. It also states that a "system management approach to ILS similar to that used in acquiring the system shall be maintained throughout the life cycle."

There are a number of changes to DoD Directive 5000.39 which would improve management of ETE. Specifically, standardization of support equipment could be identified as a desirable design-related support characteristic. Additionally, it could reference DoD Directive 4120.3. Currently, it references standardization in the ILS review checklist where it mentions "optimum use of standard parts and components" in accordance with DoD Instruction 4120.19, "DoD Parts Control Program," June 1981. While it is true that the topic of test equipment standardization is explicitly addressed in MIL-STD-1388-1A, we believe that this topic is important enough to be included in the procedural guidance of DoD Directive 5000.39. Accordingly, we believe that Section E 1 d of that directive, which lists seven areas of ILS program emphasis, should be changed to include maximization of support equipment commonality and utilization of standard test equipment. To achieve that result, the "Program Manager ILS Responsibilities" (Enclosure 4 of the directive) should be changed to require the program manager to address standardization of support equipment in the early phases by structuring, when appropriate, contractor incentives to reward prime equipment design characteristics that make maximum use of existing and/or preferred items of support and test equipment.

#### Selected Acquisition Issues

Several other acquisition issues not explicitly addressed by the four major directives/instructions discussed above are a recurring theme in test equipment acquisition. They include the

use of military-designed equipment versus commercial off-the-shelf equipment, the conflicts between standardization and competition, the use of warranties, and the use of multiyear contracts.

The first two issues have been discussed at length in the "Standardization" section, but we have further comments on two related directives. DoD Directive 5000.37, "Acquisition and Distribution of Commercial Products (ADCP)," 29 September 1978, directs DoD Components to "purchase commercial off-the-shelf products when such products will adequately serve the Government's requirement, provided such products have an established commercial market acceptability, and use commercial distribution channels in supplying commercial products to users when it is economically advantageous to do so and the impact on military readiness is acceptable." DoD logistics policy for the use of commercial products needs some clarification. With respect to competition, the recently issued DoD Directive 4245.9, "Competitive Acquisitions," 17 August 1984, establishes policy and procedures for the competitive acquisition of goods and services for the DoD in accordance with the FAR and DFARS. As a result of its emphasis on competition, this directive strengthens the perception that *standardization is illegal*. *The next revision of the directive should state that there are specific exceptions permitted under law, including formal standardization items, and provide procedural guidance*

The third issue, the use of warranties, has become a mandatory requirement for weapons systems contracts awarded after 1 January 1985 (unless a waiver is authorized). DoD policy is still evolving in this area, with temporary regulations provided in DFARS 46.7. Importantly, the warranty requirements resulting from the Defense Procurement Reform Act and associated regulations do not apply to support equipment nor to commercial items sold in substantial quantities to the general public (DFARS 46.770-1, "Definitions," as updated by Defense Acquisition Circular 84-9, 2 January 1985). With regard to warranty requirements for commercial equipment, the FAR is very flexible:

If a warranty of commercial items is appropriate, the contracting officer may include a warranty of supplies clause modified for commercial items. . . . The Government may adopt the contractor's standard commercial warranty if the contracting officer determines it is not inconsistent with the rights that would be afforded the Government under a warranty of supplies clause [FAR 46.709]

In a previous report (Warranties On Commercial Items Within DoD, October 1980), the Logistics Management Institute concluded there is little to gain by refusing a standard warranty offered to all buyers because prices are rarely reduced for warranty exclusion. Except for "in-house service" warranties, which permit warranty repairs by the user with cost reimbursement by the manufacturer, warranties are generally of little benefit to the DoD because of the extensive burden of administering them. However, in-house service warranties have the potential to increase equipment availability, permit better control over the quality of warranty repairs, and eliminate the risk of voiding a warranty. Such warranties are currently rare or nonexistent within the DoD but are, for example, used by the General Services Administration for vehicle repair.

The fourth issue, multiyear contracting, is important for test equipment procurement because it eliminates the problems associated with reprocurring the same item under multiple separate contracts (often forced into competition and resulting in proliferation). Other advantages include quantity discounts and reduced administrative costs and delays. Since the legislation authorizing this contracting method is so recent, the Military Services have seldom used it to procure test equipment. (The Army has been procuring common ETE, as part of its TMDE Modernization Program, under contracts with annual renewal options that capture many but not all of the benefits of a multiyear contract.) DoD guidance on general criteria for multiyear procurement is provided in DoD 7110.1-M, "DoD Budget Guidance Manual," 8 July 1982 and DoD Directive 7200.4, "Full Funding of DoD Procurement Programs," 6 September 1983. The latter document permits two types of exceptions: advance procurement for long lead-time items (an exception that has always been available) and advance economic order quantity procurement (a new exception that facilitates multiyear contracting). The latter exception allows the use of advance procurement in a multiyear contract to purchase more than 1 fiscal year's program increment of materiel in order to obtain the economic advantages of multiyear procurement. A multiyear contract is defined as a contract covering current and future-year procurement quantities of items (but no more than 5 years) as reflected in the Five-Year Defense Program, with each program year budgeted and funded annually. At the time a multiyear contract is awarded, funds need to have been appropriated for only the first year. The directive

explicitly points out that these advance procurement techniques (i.e., in advance of need) may be used in all multiyear procurements, including those funded in the Other Procurement Appropriation (i.e., the appropriation under which test equipment would be procured). This revision of DoD Directive 7200.4 has thus removed the major barrier to multiyear contracting for test equipment (in the past, such contracts had to be fully funded).

### LIFE CYCLE SUPPORT

This section focuses on maintenance policy, quality assurance, and provisioning and supply

#### Maintenance

The key policy document for field-level maintenance is DoD Directive 4151.16. As described previously, however, this directive focuses on weapons and equipment end-item systems. It does not specifically single out support equipment, but implies that support equipment is included as end-item systems.

The primary directive pertaining to depot maintenance is DoD Directive 4151.1, "Use of Contractor and DoD Resources for Maintenance of Materiel," 15 July 1982. It states that direct maintenance (organizational and intermediate) for assigned materiel shall be performed, to the maximum extent possible, by combat and direct combat support activities, but that interim contractor maintenance shall be used with the introduction of new weapons systems until system design, R&M characteristics, maintenance procedures, and maintenance training have stabilized. Continued use of contractor personnel throughout the system life cycle is only permitted if there are shortages in skilled military maintenance personnel and if such contractor personnel will provide wartime support in a combat zone. For other than combat and direct combat support materiel (for example, support equipment as we interpret it), the source of direct maintenance support (DoD military or civilians, contractors, or host nation support) will be selected on the basis of (1) need to maintain a training and rotational base for military technicians, (2) security implications, (3) timely availability of commercial sources or host nation support, and (4) cost effectiveness. With respect to depot maintenance, the directive requires that a competitive commercial depot maintenance industrial base be established and maintained and be capable of expanding during mobilization. It states

explicitly that organic depot maintenance capabilities shall be kept to the minimum required to ensure a ready source of technical competence and resources to meet military contingencies and requires the DoD Components to use a "decision tree," approved by the Assistant Secretary of Defense (Acquisition and Logistics), for assigning source of repair responsibilities and for determining the minimum organic resources required for mobilization. Unless justified by that decision tree, the directive puts a cap on the organic depot maintenance workload in total (by commodity grouping, not by individual weapons system) by requiring that at least 30 percent of the gross mission-essential and all of the nonmission-essential workload shall be opened to nonorganic support. It further requires a Joint Support Plan whenever the same weapons system or equipment is being procured for use by two or more DoD Components.

The DoD also has issued a series of directives/instructions on DoD Commercial and Industrial-Type Activities, which are activities operated and managed by DoD Components to provide products or services that are also obtainable from a private, commercial source. Commercial and Industrial-Type Activities must be approved on a case-by-case basis in accordance with explicit guidelines.

DoD Directive 4000.19, "Interservice, Interdepartmental, and Interagency Support," October 1980, sets policy on both retail and wholesale interservice support.

DoD Instruction 7220.21, "Uniform Criteria for Repair Cost Estimates Used in Determination of Economical Repair," May 1973, provides standard criteria and principles for setting maintenance expenditure limits used in determining eligibility for economic repair. An economic repair is defined as a repair that costs less than the value of the estimated remaining useful life of the item at a point in time based on life expectancy, replacement cost, and other factors. The economic determination and updating of expenditure limits for test equipment appears to be critical to a well-managed replacement or modernization program.

#### Quality Assurance

The key policy directive on quality assurance is DoD Directive 4155.1, "Quality Program," 10 August 1978. That directive requires DoD Components to manage a quality program to



assure (1) operational effectiveness and user satisfaction with DoD products, (2) conformance to specified requirements, and (3) cost effectiveness. The scope of the program is illustrated by Figure 2-1, which is taken from that directive. The directive also charges USDR&E with policy direction for metrology and calibration; Assistant Secretary of Defense (Manpower, Installations, and Logistics), ASD(MI&L), with responsibility for assuring that effective metrology and calibration services are provided; and Joint Technical Coordinating Group for Metrology and Calibration with providing interservice coordination of the DoD Metrology and Calibration Program.

#### Provisioning and Supply

DoD Instruction 4115.1, "DoD Coordinated Procurement Program - Purchase Assignments," 1 September 1972, sets forth the objective to integrate military procurement functions to the maximum extent practicable. It states that any materiel used by at least two DoD Components and procured in sufficient quantity on a repetitive basis to warrant the expectation of savings to result from coordinated procurement will be considered by the ASD(MI&L) for assignment to one of the DoD Components. Assignments are made by FSC or by homogeneous groups of items. The Director, Defense Logistics Agency (DLA), is charged with administering the coordinated procurement program. The enclosure to DoD Instruction 4115.1 lists the FSCs assigned to each DoD Component. (For maximum effectiveness, coordinated procurement responsibility should be assigned in accordance with the assignee activities listed in the Standardization Directory.) This instruction needs to be updated.

DoD Directive 4140.40, "Provisioning of End Items of Materiel," 28 June 1983, is the key policy guidance for initial provisioning. It provides clear, comprehensive procedural guidance on provisioning for materiel end items, not on the logistic support of support equipment.

#### INVENTORY MANAGEMENT

DoD policy guidance in the area of inventory management focuses on item management, inventory control and reporting, cost reporting, and obsolescence.

FIGURE 2-1 QUALITY PROGRAM REQUIREMENTS FOR MAJOR SYSTEM ACQUISITION AND DEPLOYMENT (CONTINUED)

PHASE	CONCEPTUAL	VALIDATION	FULL-SCALE DEVELOPMENT	PRODUCTION	DEPLOYMENT
MILESTONE	0 (Program Initiation)	I (Demonstration and Validation)	II (Full Scale Development)	III (Production and Deployment)	
QUALITY PHASED ACTIVITIES	<ul style="list-style-type: none"> <li>Review approved mission element need statements</li> <li>Review parametric data on similar systems</li> <li>Analysis for determining minimum essential quality characteristics and R&amp;M</li> <li>Develop initial QA plans</li> <li>Perform (quality) assessment</li> </ul>	<ul style="list-style-type: none"> <li>Identify and define quality (physical, technological, psychological, and time oriented) characteristics</li> <li>Evaluate inhouse or contractor proposals for engineering development</li> <li>Prepare contract provisions for quality during development</li> <li>Identify special acceptance inspection equipment (SAIE) requirements</li> <li>Prepare test equipment calibration procedures</li> <li>Develop metrology and calibration plans for the product</li> <li>Perform independent (quality) assessment</li> <li>Update and refine quality requirements and QA plan for development</li> </ul>	<ul style="list-style-type: none"> <li>Productibility and quality engineering analysis</li> <li>Identify manufacturing, special production processes, and quality control methods</li> <li>Identify critical items</li> <li>Develop critical item planning</li> <li>Identify potential problem areas/risks</li> <li>Develop SAIE</li> <li>Perform design review for quality characteristics</li> <li>Initiate cost effective engineering changes</li> <li>Evaluate mfg &amp; assembly operations for ease of examination and test</li> <li>Develop test procedures</li> <li>Identify NATO interfaces</li> <li>Prepare contract provisions for quality production</li> <li>Develop transition plan to prevent degradation of quality in production</li> <li>Perform independent (quality) assessment</li> </ul>	<ul style="list-style-type: none"> <li>Establish baseline control of engr. changes and configuration</li> <li>Provide for monitoring contractor or inhouse quality</li> <li>Quality inputs to production</li> <li>Provide for product and service quality audits</li> <li>Depot maintenance work requirements</li> <li>Destination depot QA programs product acceptance</li> <li>Data feedback system with (deployment)</li> <li>Product quality training programs user orientation</li> <li>Logistics provisioning QA program</li> <li>Update and implement QA plans</li> <li>Perform independent (quality) assessment</li> </ul>	<ul style="list-style-type: none"> <li>Monitor initially deployed system (assure user satisfaction)</li> <li>Implement storage and distribution QA plans</li> <li>Implement operations QA plans</li> <li>Implement military service QA plans for maintenance and overhaul</li> <li>Storage serviceability standards and cyclic inspection instructions</li> <li>Independent (quality) assessment of deployed systems and feedback system</li> </ul>
CONTINUING ACTIVITIES	<div>Assess Quality of Weapon Systems To Identify Requirements Achievements, Needed Quality Improvements and Unmet Needs</div> <div>Quality Assurance Programs for Services Procured Relative to Systems Acquisition and Deployment</div> <div>Tailoring of Specifications, Standards, and Data Requirements Related to Quality Assurance</div> <div>Provision of Metrology and Calibration Services</div> <div>Quality Data Feedback and Utilization</div>				
	<div>DISPOSAL</div> <ul style="list-style-type: none"> <li>Develop phase out and disposal plans               <ul style="list-style-type: none"> <li>QA Plan</li> <li>Decontamination</li> <li>Sales</li> </ul> </li> </ul>				

\* First amendment (Ch 1, 1/19/79)

SOURCE: Department of Defense, "Quality Program," DoD Directive 4155.1 (Washington, D.C.: Department of Defense, 10 August 1978)

### Item Management

DoD Instruction 4140.7, "Control, Supply, and Positioning of Materiel," 12 January 1965, classifies defense materiel into two categories: centralized items and decentralized items. Centralized items are those for which the cognizant inventory control point exercises prescribed central management (i.e., requirements determination, supply, control, production, distribution, and stockage). Decentralized items are those for which local management is authorized, including items that the DoD obtains from the General Services Administration. The instruction provides a decision tree for the inventory control point's determination of the feasibility and desirability of either centralized or decentralized management for each assigned item. Except for commercially available items that are deliverable within 30 days and with an annual demand of \$100 or less, test equipment normally qualifies for centralized management. Commercial items that do not meet those criteria must still be considered for decentralized management.

### Inventory Control

DoD Instruction 4140.35, "Physical Inventory Control for DoD Wholesale Supply System Materiel," October 1982, sets policy on inventory control. It requires each DoD Component to establish a physical inventory program for wholesale supply system materiel and to conduct inventories on all items. It also establishes a Joint Physical Inventory Working Group to develop or recommend policies or improvements for inventory control.

DoD Instruction 4140.18, "Inventory Management Report of Materiel Assets," November 1981, prescribes the reporting of principal items and secondary items, but the item categories identified in this instruction do not include support and test equipment.

DoD Directive 4140.32, "Defense Inactive Item Program," May 1980, establishes policy for eliminating unessential expenditures by purging inactive items from DoD inventories and Federal Supply Catalogs. Inactive items are defined as items for which no current or future requirements are recognized by the user or item manager.

The first two instructions provide the Military Services with considerable latitude in monitoring their test equipment inventory, while the "inactive item" directive prescribes that the supply system be purged on a regular basis.

#### Cost Reporting

DoD Directive 7220.33, "Reporting of Operating and Support Costs of Major Defense Systems," 19 May 1984, implements the principles of "management-by-objective" and establishes the Visibility and Management of Operating and Support Costs (VAMOSC) program for identifying and reporting historical operating and support costs of major defense systems. The Military Services are required to establish and maintain VAMOSC systems to monitor those costs, including displays of logistic support costs at the subsystem level. Although test equipment costs are supposedly included in the various cost categories, current systems do not permit extracting the cost for test equipment as a separate category or for each category of test equipment, primarily because VAMOSC is weapons-system oriented.

#### Obsolescence

Probably the most important policy guidance for test equipment inventory management is the recently reissued DoD Directive 4005.16, "Diminishing Manufacturing Sources and Material Shortages Program," 16 May 1984. It requires DoD Components to minimize the impact on the acquisition and logistics system when a development program, end-item production schedule, or spare part support capability is endangered by diminishing manufacturing sources and material shortages. It provides detailed procedural guidance on how to do this. Item managers who are looking for further information on how to solve these types of "support obsolescence" problems are referred to a recent thesis from the Air Force Institute of Technology.<sup>3</sup> That thesis recommends the

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<sup>3</sup>Captain David Capotosti, U.S. Air Force, "A Study On the Effects of Diminishing Manufacturing Sources on the Supportability of the AN/ASQ-38 Radar System" (Wright Patterson Air Force Base, Ohio: Air Force Institute of Technology, June 1981) (AD A105185).

following methods, in priority order, for moderating the impact of diminishing manufacturing sources:

- Improved long-range forecasting and policy for spares acquisition (the latter has been implemented with the revision of DoD Directive 7200.4 described earlier)
- Multiyear procurement
- Standardization
- Greater use of performance specifications instead of design specifications
- Shorter weapons systems acquisition program cycles
- Increased responsiveness to technological change
- Increased DoD-industry communication.

As illustrated by the above alternatives, item managers have a number of options available to them to aid in minimizing the effects of diminishing manufacturing sources.

#### CATALOGING

Central to the effective management and support of test equipment is the availability of adequate data (identification, technical description, and repair parts) on existing test equipment in the DoD inventory. The Federal Catalog System was established as the central data source for all DoD items of supply that are repetitively procured and subject to central management. The system does not apply to research and development items; major end items (ships, planes, tanks); contracted services; one-time buys; and pieces of end items not required for maintenance. The central data base, Defense Integrated Data System (DIDS) Total Item Record (TIR), was implemented in March 1975. It is maintained by the Defense Logistics Services Center, Battle Creek, Michigan, and is the repository of all reference numbers relating to items of supply cataloged under provisions of the Federal Catalog System of which DLA is the administrator. The TIR, supported by the automated edit and validation processes, is designed to provide all information relating to any item of supply included in the Federal Catalog System. Policy and procedural guidance is provided by DoD 4130.2-M, "Federal Catalog System Policy" and DoD 4100.39-M, "DIDS Procedures Manual."

The DIDS TIR affects virtually all logistics functions, including standardization, provisioning, and maintenance support. The system contains approximately 5 million line items and over 10 million reference numbers. (A reference number is defined as any number other than a stock number used to identify an item of supply. Reference numbers include manufacturer's part numbers, specification or standard part numbers, drawing numbers, etc. The Military Services are required to submit directly to Defense Logistics Services Center all known reference numbers related to an item of supply for entry into the DIDS TIR.) DLA publishes a Master Cross Reference List relating national stock numbers and permanent system control numbers to part numbers and organizational entity codes. (Permanent system control numbers are the result of standardization actions and serve to establish preferred items in the TIR data base.) It also publishes a series of handbooks for verifying reference numbers. The DLA has recently begun to install DIDS remote terminals for on-line access.

The shortcomings in the cataloging process are much broader than the issue of test equipment management, but they are key to making the necessary improvements in test equipment management. While DoD guidance on the cataloging process appears adequate, the operations of the Federal Catalog System need to be strengthened.

#### READINESS MONITORING

This section describes current policies pertaining to materiel readiness reporting. The two major reporting systems are the Materiel Condition Reporting System established by DoD Instruction 7730.25, "Materiel Condition Reporting for Mission-Essential Systems and Equipment," 22 May 1980; and the Military Capability Reporting System established by Joint Chiefs of Staff (JCS) Memorandum of Policy No. 172 issued 20 April 1971 and revised on 1 June 1982.

DoD Instruction 7730.25 requires the Military Services to collect and report condition status information on mission-essential materiel, compare it with established goals, identify materiel problems that adversely affect materiel condition, and develop remedial actions. Condition status measurement is in terms of the percentages of time that materiel is either fully mission capable (FMC), partial mission capable (PMC), or not mission capable (NMC). For reporting purposes, mission capable rate is the sum of FMC and PMC. Further, NMC is subdivided by cause, either it is

due to maintenance or supply. The definition of mission-essential materiel apparently needs to be expanded to include support equipment. This action would then reveal the contribution of test equipment to mission-capable problems.

The JCS Military Capability Reporting System comprises two types of reports, the *Commander's Situation Report* and the *Unit Status and Identity Report* (UNITREP). Over the years, many studies have been devoted to the complex subject of readiness or capability reporting and possible improvements to UNITREP. Rather than delving into those issues, we refer to a recent compilation prepared by the GAO,<sup>4</sup> and address on the issue of the extent to which the current UNITREP includes measures of test equipment on-hand and ready. UNITREP provides an overall combat rating (C-rating) for each combat, combat support, and combat service support unit. The overall unit C-rating equals the lowest rating achieved in the four resource areas of personnel, equipment/supplies on-hand, equipment readiness, and training. The resource area C-ratings are based on stated criteria. The criteria for equipment on-hand and equipment readiness are in terms of *percentage of wartime requirement for total Military Service-selected combat-essential equipment* and for selected major end items (i.e., number possessed divided by number required and number possessed and combat ready divided by number required, respectively).

The UNITREP leaves it up to the Military Services whether to include test equipment in the equipment/supplies on-hand resource area. Although we have not examined the readiness reporting regulations of the Military Services, past studies have indicated that test equipment is normally not included. The Air Force is currently examining the possibility of reporting availability of calibration equipment at Precision Measurement Equipment Laboratories as well as availability of major test equipment items such as ATE through UNITREP.

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<sup>4</sup>U S General Accounting Office, Measures of Military Capability: A Discussion of Their Merits, Limitations, and Interrelationships, NSIAD-85-75 (Washington, D C U S General Accounting Office, 13 June 1985)

### 3. SUMMARY

Current DoD policy on the management and support of test equipment does not differentiate between the administration of standardized documents and the control of test equipment proliferation, does not establish standardization of support equipment as a desirable support characteristic, and does not prescribe detailed guidance on the development of test equipment maintenance plans. This report contains a number of suggestions on how to correct these and other oversights, the implementation of which should enhance overall test equipment management and support within the DoD.



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<p>Since the early 1970's, the Office of the Secretary of Defense, the Military Departments, and industry have sponsored numerous studies of test equipment, formed several joint panels to investigate selected technical issues, and initiated a variety of programs to correct identified problems. Despite such attention, the Department of Defense still faces many significant problems with fielded test equipment.</p> <p>In a previous report, <i>Test Equipment Management</i>, January 1985, we summarized the nature and extent of those problems and recommended the Assistant Secretary of Defense (Manpower Installations, and Logistics), ASD(MI&amp;L), take the lead in effecting needed improvements in test equipment management and support. The ASD(MI&amp;L) concurred with that recommendation and established, via an action memorandum for the Under Secretaries of the Military Departments, dated 26 June 1985, a "DoD Test Equipment Management Improvement Program" under the overall guidance of his Maintenance Directorate.</p> <p>Since the issuance of that action memorandum, the Maintenance Directorate has been coordinating DoD-wide efforts to implement the DoD Test Equipment Management Improvement Program. This report, which is published in four volumes, bolsters the Maintenance Directorate's initiative. Volume I lays out a specific program of action for the Assistant Secretary of Defense (Acquisition and Logistics) to serve as a cornerstone for the DoD Test Equipment Management Improvement Program; Volume II reviews previous studies and initiatives pertaining to test equipment management and support; Volume III describes how the Military Departments are organized to carry out that management and support; and Volume IV reviews and assesses the adequacy of DoD policy.</p>					
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